COMMONWEALTH OF AUSTRALIA

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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2, 2015

FINAL EXAMINATION	**DURATION**
ENG267 – Hydraulics and Soil Mechanics	Reading Time: **10** minutes Writing Time: **120** minutes

INSTRUCTIONS TO CANDIDATES

EXAM CONDITIONS

This is a CLOSED BOOK examination

Any non-programmable calculator is permitted

No handwritten notes are permitted

No dictionaries are permitted

Answer on the supplied examination material/s only

ADDITIONAL AUTHORISED MATERIALS	**EXAMINATION MATERIALS TO BE SUPPLIED**
No additional printed material is permitted	1 x 16 Page Book

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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SECTION A

Answer all questions

Each question is worth 4 marks (Total Marks 40)

Wherever possible use sketches and diagrams to explain your answer.

Q.1

What is optimum water content?

Q. 2

Explain briefly the object of classifying soil for engineering purposes? What are the physical properties and factors which are considered in classifying a soil?

Q. 3

If the void ratio of a soil sample is 0.73 what is the porosity?

Q. 4

Differentiate between total pressure and effective pressure of water.

Q. 5

Explain the terms Liquid Limit, Plastic Limit and Plasticity Index and briefly describe how they are measured.

Q. 6

A moist sample of soil in a bottle had a mass 24.60 g and the bottle, when empty, has a mass of 15.2 g. After drying in an oven for 24 hours, the bottle and soil sample had a mass of 21.60 g. find the percentage of water content of the soil.

Q. 7

With the aid of a diagram explain the different types of subsurface water that can be found under a surface.

Q. 8

What is piping in granular soils?

Q9

What are a stream line and an equipotential line in the context of a flow net?

Q10

Explain the term Relative Compaction.

SECTION B

Answer all questions

Each question is worth 15 marks (Total Marks 60)

Wherever possible use sketches and diagrams to explain your answer.

Q. 1 **(15 Marks)**

Using a phase diagram and basic definitions of the properties of soil, establish the formula for Bulk Density of unsaturated sample as p_w x $(G_s+se)/ (1+e)$.

An undisturbed soil sample has the following data:
Void ratio = 0.75
Water content = 14%
Specific gravity = 2.7

Calculate the following:

a) Bulk Density
b) Dry Density
c) Degree of Saturation and
d) Porosity

Q. 2 **(15 Marks)**

In a standard compaction test on a soil which has specific weight of 2.7, the following results were obtained:

Water content %	Bulk density (Mg/m^3)
5	1.89
8	2.13
10	2.20
12	2.21
15	2.16
20	2.08

Sketch an appropriate graph and find the following values of the soil at the optimum water content.
Void ratio.
Porosity.
Degree of saturation.

Q. 3 **(15 Marks)**

Describe with a neat sketch the constant head permeameter. Assuming Darcy's law, derive an expression for the coefficient of permeability.

Calculate the coefficient of permeability of a sample given the following data.

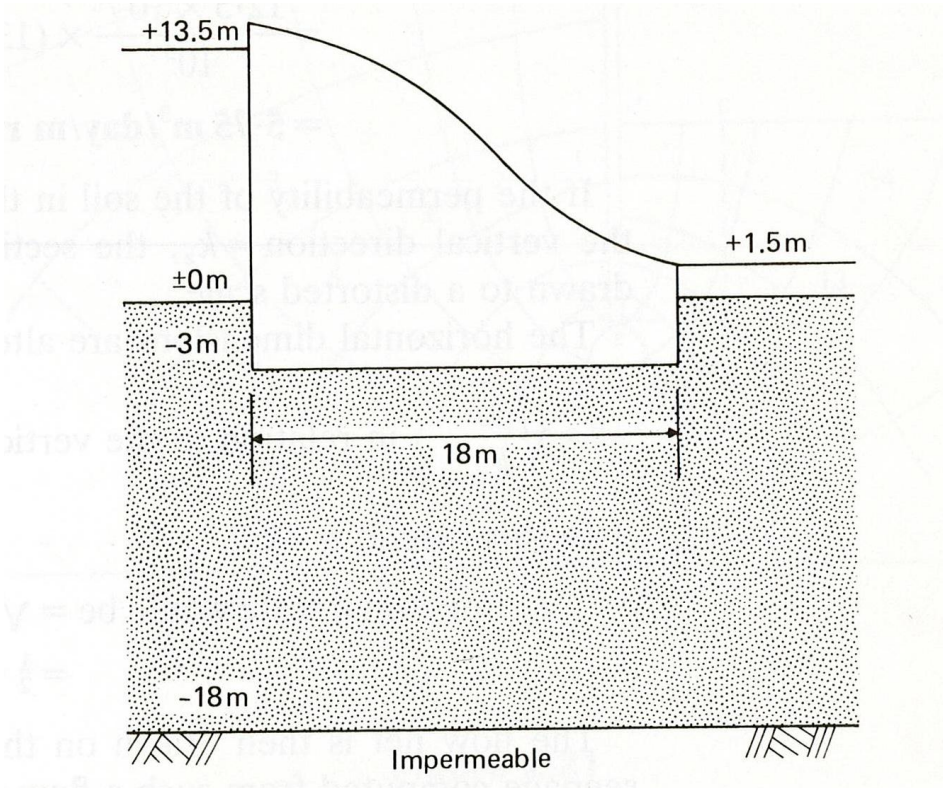
Diameter of permeameter	75mm
Loss of head on a 200mm length	83.2mm
Water collected in 1 min	66.8ml

Q. 4 **(15 Marks)**

(a) Discuss the principles involved in sketching a flow net.

(b) The figure below shows the cross-section of a concrete dam founded on slightly permeable soil, below which there is an impermeable stratum. Roughly sketch the flow net, assuming the soil to be isotropic and use the sketch to find the rate of seepage of water under the dam if k for soil = 12.5 x 10^{-3} mm/s.

What modifications would you make if the permeability in the horizontal direction is four times that in the vertical direction?



USEFUL FORMULAS FOR SOIL

Void ratio $e = V_v/V_s$

Porosity $n = V_v/V_t$

$h_c = 0.15/D_{10}$

Degree of Saturation $S = (V_W/V_v) \times 100\%$

Moisture content $w = (M_w/M_s) \times 100\ \%$

Porosity $n = e/(1+e)$

Bulk Density $p_b = p_w(G_S+eS_r)/(1+e)$

Dry Density $p_d = (p_wG_s)/(1+e) = p_b/(1+w)$

Saturated Density $p_{sat} = ((G_s+e)/(1+e))p_w$

Water Content $w = (se)/G_s$

$K = (QL)/(Ah_L)$

$K = ((al)/(At))\ln(h1/h_2)$

$K = (Q/\pi(h_2^2-h_1^2))\ln(r2/r_1)$

$Q = kh_L(N_f/N_d)(a/b)$